No. 690,542. Patented Jan. 7, 1902.

H. F. WALLMANN.

INTERNAL COMBUSTION OIL ENGINE.

(Application filed Feb. 3, 1900.)

(No Model.) 3 Sheets—Sheet I.

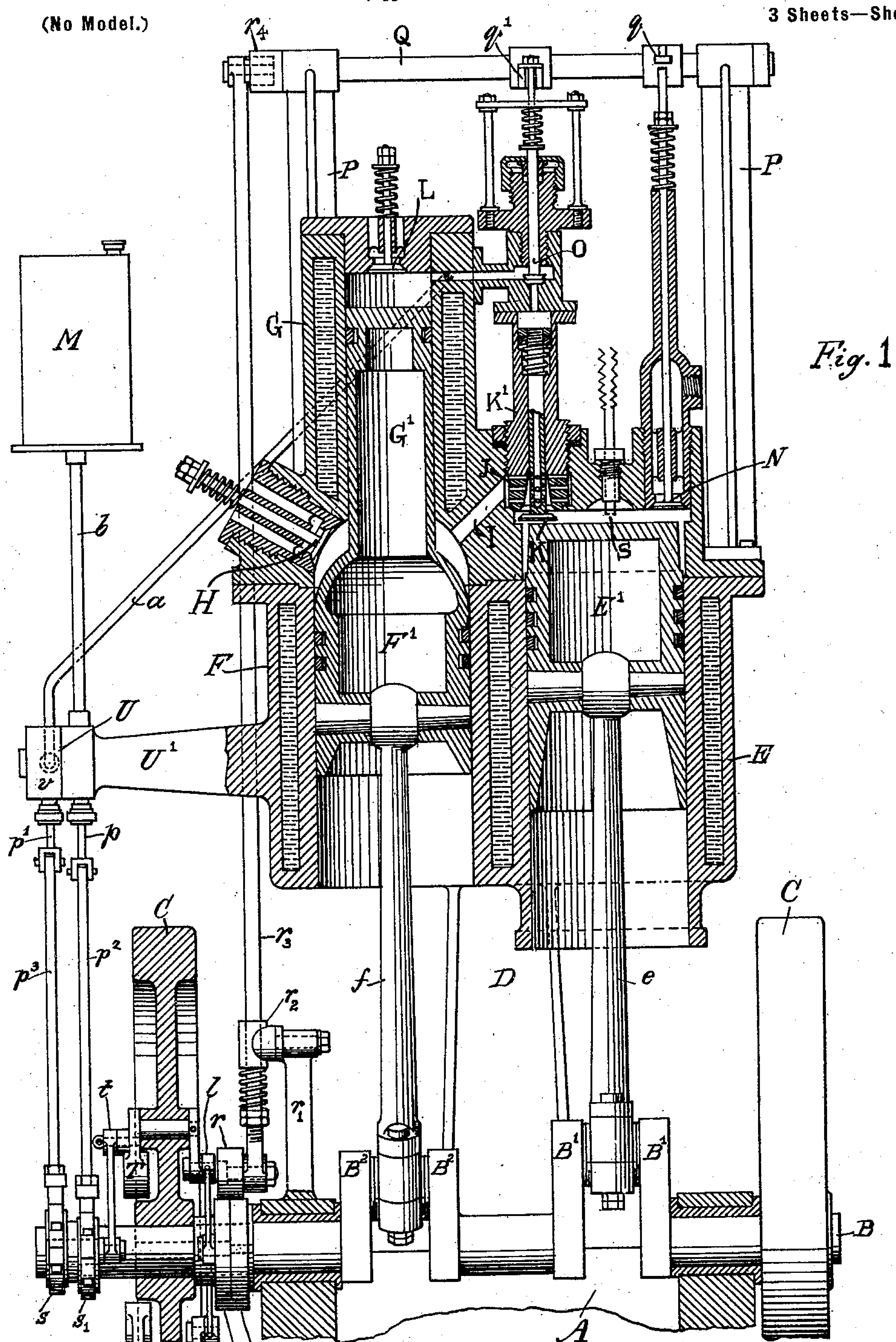

Fig. 1

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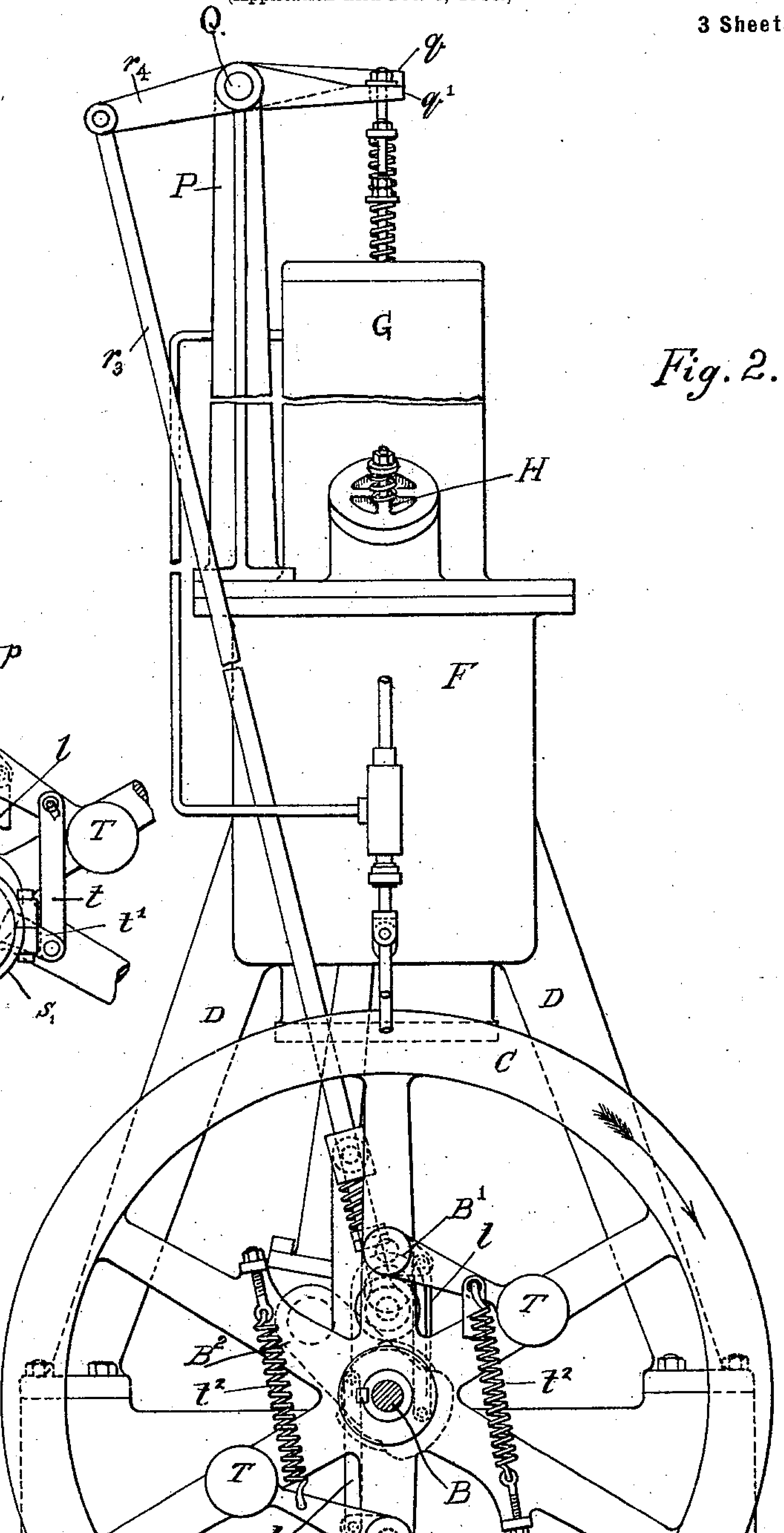
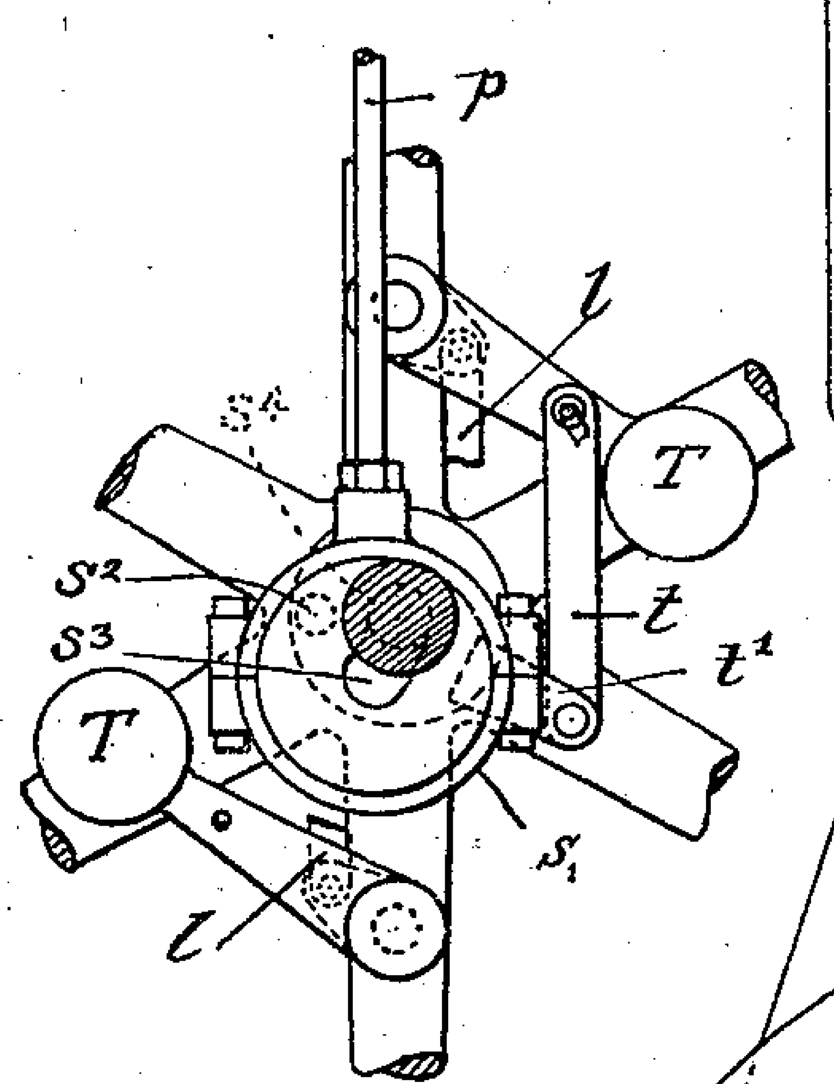


Fig. 2.

Fig. 3.



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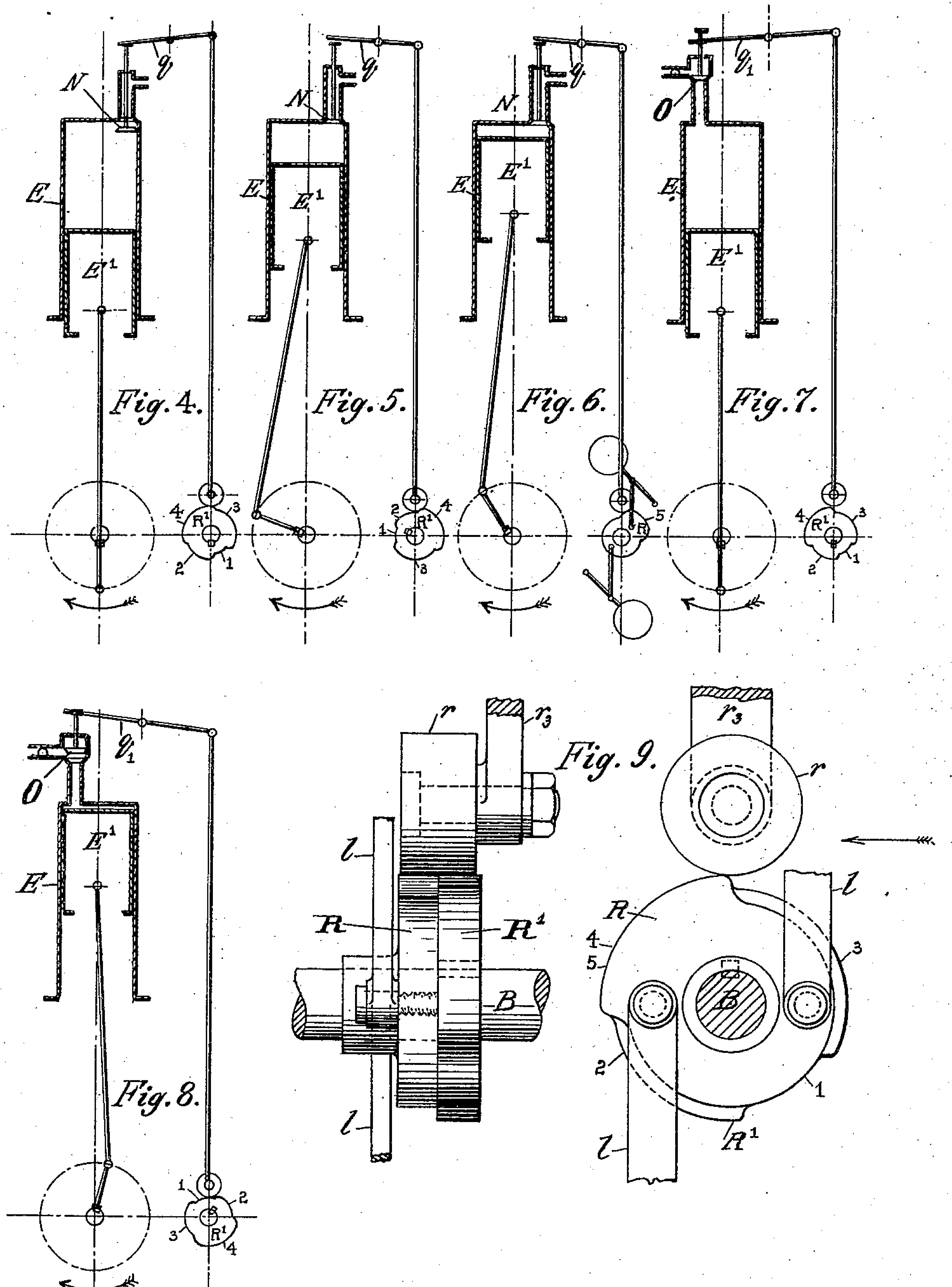

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UNITED STATES PATENT OFFICE.

HENNING FRIEDRICH WALLMANN, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WALLMANN ENGINE COMPANY, A CORPORATION OF ILLINOIS, ORIGINALLY DESIGNATED AS THE WALLMANN INTERNAL-COMBUSTION ENGINE COMPANY.

INTERNAL-COMBUSTION OIL-ENGINE.

SPECIFICATION forming part of Letters Patent No. 690,542, dated January 7, 1902.

Application filed February 3, 1900. Serial No. 3,841. (No model.)

To all whom it may concern:

Be it known that I, HENNING FRIEDRICH WALLMANN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Oil-Engines, of which the following is a specification.

My invention relates to internal-combustion engines of the two-cycle type in which a charge of compressed air is mixed in suitable proportions with an inflammable oil-vapor, ignited and expanded within the combustion-cylinder, and made to perform work against the piston at every outstroke of the latter. In two former applications for Letters Patent, Serial Nos. 718,904 and 739,962, filed May 31 and December 11, 1899, respectively, I have shown and described engines of this general type and character more especially designed and adapted to the use of gas as a fuel. My present invention embodies the general principles of construction and operation disclosed in the aforesaid applications, but modified and changed in their embodiment to suit the use of a liquid fuel—such as gasolene, kereosene, crude petroleum, &c.—together with certain improvements in the valve-actuating and speed-controlling mechanism as applicable to an engine of this type, as will be fully hereinafter described.

To these ends my invention consists in an internal-combustion oil-engine possessing certain novel features of construction and operation, as hereinafter described, and particularly pointed out in the claims.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a view principally in central vertical section, broken away, of my improved oil-engine. Fig. 2 is a side view, broken away, of the engine, showing the valve-actuating connections and the oil-pump. Fig. 3 is a detail side elevation of the governor-controlled oil-pump-actuating mechanism. Figs. 4 to 8, inclusive, are diagrammatic views illustrating various positions of the valve-actuating mechanism at different points in the strokes of the working and pump pistons; and Fig. 9 is a view in edge and side elevation, broken away, of an automatically-adjustable two-member valve-actuating cam.

Similar characters of reference refer to similar parts throughout the several views.

A represents the base or bed-plate of the engine, in which is journaled the crank-shaft B, carrying a pair of fly-wheels C. Supported vertically on the bed-plate A is a framework D, which supports at its upper end a combustion-cylinder E and an air-pump cylinder F. Arranged tandem with and forming an extension of the air-pump cylinder F is the cylinder G of another and smaller air-pump, the plungers F′ and G′ of the said pumps, respectively, being formed integral, as shown, or rigidly connected together, so as to move simultaneously under impulses imparted from the crank-shaft B through crank B^2 and connecting-rod *f*. Within the combustion-cylinder E is the working piston or plunger E′, the latter connected to and operating the crank-shaft B through the agency of connecting-rod *e* and crank B′. It will be noticed that the two cranks B′ and B^2 are not set in parallel relation to each other on the crank-shaft B, but about one-eighth of a revolution apart, the crank B′, connected to the working piston E′, being approximately forty-five degrees in advance of the crank B^2, which actuates the pump-plungers F′ and G′. The purpose of this relative arrangement of cranks will be disclosed later in the description of the operation of the engine.

Referring to the larger air-pump F, it will be noticed that the presence of the elongated plunger G′, formed directly on the upper face of the air-pump plunger F′, creates an annular air-compression chamber within the cylinder F, to which air is admitted on the suction-stroke through the inlet-valve H and out of which it is forced on the compression-stroke through a port I and a mixing device J past valve K into the combustion-cylinder E. The function of this air-pump is to scavenge the combustion-cylinder at and during the proper time in the latter's operation and later to supply compressed air for the combustible charges introduced into cylinder E, while the function of the smaller air-pump G, to which air is admitted on the suction-stroke through an inlet-valve L, is to facilitate the introduction of the oil fuel to the combustion-cylinder in a sprayed and finely-divided condition by causing a blast of air under somewhat-greater pressure than the air in cylinder F to impinge upon the oil on its way to the combustion-cylinder, as hereinafter more particularly described.

Referring now to the combustion-cylinder, K is its inlet-valve, and N designates its exhaust-valve. The latter is normally held to its seat by a spring, as shown, but is positively opened at and during the proper period in the engine's operation to effect the exhaust and scavenging of the combustion-cylinder, as hereinafter described.

In a suitable canal or passage-way connecting the upper end of the air-pump G with the combustion-cylinder I provide in addition to the regular automatic inlet-valve K of the latter cylinder a positively-actuated fuel-controlling valve O, which by means hereinafter described is opened after the closing of the exhaust-valve of the combustion-cylinder to admit the oil fuel commingled with and forced and sprayed by compressed air from the pump G into the latter cylinder. The inlet-valve K of the combustion-cylinder has a hollow stem of considerable length provided with a plurality of fine lateral ports near its lower end, as shown, and its casing K′ is similarly ported near its lower end opposite the port I, so that the compressed fuel entering through the hollow valve-stem and the compressed air entering through port I will be forced in opposite directions to meet each other in fine sprays through the lateral ports in the valve-stem and its casing, respectively, and will enter the combustion-cylinder past the valve K in a thoroughly-commingled state. Further detailed description of this mixing device is not here given, as it is not herein specifically claimed, but forms the subject-matter of a companion application, Serial No. 8,132, filed March 10, 1900.

Referring next to the means for supplying oil for the combustible charge, U indicates an oil-pump secured to a bracket U′, shown as formed integral with the air-pump cylinder F. M is an oil-tank, and b is a pipe through which the oil flows by gravity to the upper end of the oil-pump. The plunger p of the oil-pump is actuated through a rod p^2 from an eccentric s', while the slide-valve p', that controls the discharge of oil from the valve-chest, is actuated through a similar rod p^3 and eccentric s. The specific construction of this oil-pump is not herein shown and described, as it is practically the same as the well-known Brayton oil-pump and possesses no novelty of itself.

Fig. 3 illustrates a governor-controlled mechanism I have devised for automatically regulating the stroke of the oil-pump plunger in accordance with the speed of the engine. The eccentric s' is pivoted at s^2 in the end of the shaft B and has an arc-shaped slot s^3 cut therethrough and playing over a pin s^4, which latter is concentric with the shaft B. The eccentric is connected by an arm t' and link t with a centrifugal ball-governor T, mounted in one of the fly-wheels C. When the arms of the governor spread, in consequence of increased speed, against the resistance of the springs t^2, normally tending to draw them together, the eccentric s' will be drawn toward or to a concentric position with relation to the shaft B, whereby the stroke of the oil-pump plunger will be shortened or caused to cease altogether, thereby reducing or cutting off the supply of oil to the combustion-cylinder through the pipe a, which, as shown in Fig. 1, leads from the valve-chest v to a point in the canal connecting the air-pump G with the combustion-cylinder between said air-pump and the fuel-controlling valve O.

Referring now to the mechanism for actuating and controlling the valves O and N, P P designate a pair of standards mounted on top of the cylinders E and F. In the upper ends of these standards is suitably journaled a horizontal rock-shaft Q. Rigidly secured on this rock-shaft are a pair of tappets q and q', which at their outer ends engage the stems of the valves N and O, respectively, at the right times to effect the proper actuation of said valves, as hereinafter described. The rock-shaft Q is positively actuated from the crank-shaft B through the agency of a quadruple-faced governor-controlled cam-disk R′ on said crank-shaft, said cam-disk engaging and actuating a roller r, journaled in the lower end of a rod r^3, which is slidably supported in a sleeve r^2, pivoted to a bracket r', supported on the bed-plate A. The upper end of the rod r^3 is connected to a short arm r^4, fast on one end of the rock-shaft Q. The cam-disk R′ has four faces formed on its periphery. The highest face 4 extends through a little over ninety degrees and the lowest face 1 through approximately forty-five degrees. The faces 4 and 1 are the working faces of the cam, the rest of its periphery being divided between the two intermediate faces 2 and 3, which are of the same height.

On the shaft B, adjacent to the cam R′, is rotatably mounted a disk R, which is connected on opposite sides of its center by links l l with the centrifugal governor T, so as to be oscillated on its central bearing by the variations of the governor-arms. This disk through approximately three-fourths of its circumference has a radius equal to the lowest face 1 of the cam R′, and through the remainder of its circumference it has a radius equal to the radius of the highest face 4 of the cam R′. (See Figs. 6 and 9.) The width of the roller r is substantially equal to the combined widths of the cam R′ and the disk R, so as to be engaged by both the latter, as plainly shown in Fig. 9. The cam R′ and the disk R are so arranged relatively to each other that when the engine is running at normal speed the high face 5 of the disk R will lie alongside of and register with the highest face 4 of the cam R', so that the disk R will have no effect on the operation of the cam R' to vary its control of the valves; but when the speed of the engine rises beyond the desired limit the face 5 of the disk R will be shifted so as to have the effect of extending or prolonging the face 4 of the cam for a purpose and with the results hereinafter described.

S indicates an igniter located in the upper or inner end of the combustion-cylinder. It may be of any known and approved type and construction and is not therefore shown and described in detail.

The operation of my improved oil-engine is as follows: With the parts as shown in Figs. 1 and 2 the working piston E' has completed its inward stroke and is just starting on its outward or working stroke, substantially as diagrammatically indicated in Fig. 8. The descent of the cam-roller *r* from the face 2 to the lowest face 1 of the cam, as shown in Fig. 8, has just opened the fuel-controlling valve O. The oil-pump plunger *p* and the plungers F' and G' of the two air-pumps are all engaged in forcing into the working cylinder, past the valve O and through the hollow stem of the valve K and the mixer J, the components of the next combustible charge. The oil entering the canal between the air-pump G and the combustion-cylinder from the pipe *a* is caught by the blast of air from the pump G and forced in fine sprays past the open valve O down into the casing K' through the long hollow stem of valve K and the mixer J, where it is vaporized by the heat of the latter, and meeting and commingling with the air supplied by the compressor F through port I passes in a highly-combustible state into the working cylinder E. When the air and oil pump plungers have completed their forcing strokes, the working piston is about one-sixth down on its working stroke. The combustible charge is then ignited, and the resulting explosion automatically drives the valve K to its seat to prevent back-firing and forces the working piston E' to the outward limit of its stroke, as indicated diagrammatically in Figs. 4 and 7, thus performing work on the crank-shaft. During this complete outward stroke of piston E' the cam-roller has traveled over the faces 1 and 3 of the cam. As it mounted from face 1 to face 3 it allowed the fuel-controlling valve O to close to its seat under the action of its spring, and as it mounts from face 3 to face 4 it causes the exhaust-valve N to open, as shown in Fig. 4, but does not affect the closed condition of valve O, Fig. 7. Meanwhile the plungers *p*, F', and G' have all followed forty-five degrees behind the working piston E' on its outward stroke, drawing in air and oil for the next charge. As now the working piston E' moves inwardly from its outward limit, as shown in Fig. 4, to the position indicated in Fig. 5 it expels the burned products of combustion past the open valve N, being assisted through slightly more than the latter half of this movement by a scavenging blast of air from the air-pump F through port I and mixer J, the plunger F' having begun its compressing stroke. As now the cam-roller descends from face 4 to face 2 of the cam, Fig. 5, the exhaust-valve N closes, and during the travel of the roller over the face 2 of the cam air is being compressed by all three plungers E', F', and G'; but as the cam-roller descends once more from face 2 to face 1 of the cam the fuel-controlling valve O will again be lifted, the next charge of mixed air and oil-vapor will rush into the combustion-cylinder through the mixer J, and the herein-described cycle of operations will be repeated.

It will be observed that owing to the fact that the fuel and the air for the combustible charge both enter the combustion-cylinder simultaneously through the mixer J, but not in parallel directions, it is essential in order to insure the introduction of the fuel that the latter should enter the cylinder at a greater pressure than the compressed air. This is conveniently effected in the mechanism I have shown by reason of the fact that the compressor F through the first half of its forcing stroke is scavenging the combustion-cylinder and begins to compress air for the next charge only on the closing of the exhaust-valve of the combustion-cylinder, while the pump G is compressing air for spraying and blowing in the fuel from the beginning of its forcing stroke to the time the valve O opens. The air impelling the fuel into the combustion-cylinder past valve O and longitudinally through mixer J is thus under greater pressure than the air for the combustible charge entering the combustion-cylinder through port I and the lateral ports in the mixer J, which prevents the fuel being held in check or driven back through its introductory passage and insures its proper delivery to the combustion-cylinder.

Referring now to the action of the disk R with relation to the cam R', it will be noted that the function of the said disk is to govern the speed of the engine by delaying the closing of the exhaust-valve N when the speed exceeds the desired limit. Referring to Fig. 6, it will be observed that the spreading of the governor-arms under abnormal speed results in turning the disk R a greater or less distance in a direction opposite to the rotation of the cam R', thereby shifting the high face 5 of the disk partly out of register with the face 4 of the cam, and thus in effect extending or prolonging the face 4 of the cam through a greater arc, so that the roller is later in descending to the face 2 and the exhaust-valve N is later in closing, Fig. 6, and consequently a smaller charge of compressed air is admitted to the working cylinder.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an oil-engine, in combination a com-

bustion-cylinder, a low-pressure air-pump for scavenging the combustion-cylinder through a portion of the return stroke of the piston therein and for supplying compressed air for the combustion of the fuel after the scavenging operation has been completed, a high-pressure air-pump operating simultaneously with said low-pressure air-pump and having its discharge-port connected with the inlet-valve of the combustion-cylinder through a suitable canal or passage-way, an oil-pump for supplying oil fuel to the combustion-cylinder and having its delivery connected to said canal, whereby the compressed air delivered by said high-pressure air-pump impinges upon the oil and sprays and forces the same into the combustion-cylinder, a positively-actuated controlling-valve in said canal governing the time of admission of the oil fuel to the combustion-cylinder, and a mixer in said canal between the controlling-valve and the combustion-cylinder.

2. In an oil-engine, in combination a combustion-cylinder, a low-pressure air-pump adjacent to and parallel with the combustion-cylinder and having its discharge-port connected with the latter, a high-pressure air-pump in alinement with the low-pressure air-pump and operating simultaneously therewith, the connected plungers of said air-pumps following the piston of the combustion-cylinder approximately one-eighth of a turn of the crank-shaft, a delivery-canal connecting the discharge-port of the high-pressure air-pump with the combustion-cylinder, a liquid-fuel pump having its delivery connected to said canal, and a positively-actuated controlling-valve in said canal governing the time of admission of fuel to the combustion-cylinder.

3. In an oil-engine, in combination a combustion-cylinder, means for supplying compressed air thereto, an oil-pump for supplying oil thereto to be mixed with said compressed air and form a combustible charge, an adjustable cam on the crank-shaft, cam-actuated connections between said cam and the exhaust-valve of the combustion-cylinder, and a governor mechanism mounted on a moving part of the engine and connected with and controlling both the actuating mechanism of the oil-pump, thereby regulating the amount of fuel fed to the combustion-cylinder, and also the adjustable cam, and through the latter governing the time of closing the exhaust-valve of the combustion-cylinder.

In testimony that I claim the foregoing as my invention I have hereunto signed my name in the presence of two witnesses.

HENNING FRIEDRICH WALLMANN.

Witnesses:
SAMUEL N. POND,
J. K. LAMBERT.